

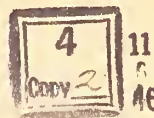
TN 295
U5
1946

LIBRARY OF CONGRESS



0 002 951 315 6

UNITED STATES
DEPARTMENT OF THE INTERIOR
J. A. KRUG, SECRETARY



U.S. BUREAU OF MINES,
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

SOME SAFETY PRACTICES FOR METAL MINES,
NONMETAL MINES (OTHER THAN COAL), MILLS,
METALLURGICAL PLANTS, AND QUARRIES



11/20
715
1946
I. C. 7387,
September 1946.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

SOME SAFETY PRACTICES FOR METAL MINES, NONMETAL MINES (OTHER THAN COAL),
MILLS, METALLURGICAL PLANTS, AND QUARRIES^{1/}

CONTENTS

	Page
Introduction.....	2
Surface conditions.....	2
1. Mills and metallurgical plants.....	2
2. Open pits, quarries, surface excavations.....	3
3. Head frame.....	4
4. Hoisting.....	5
5. Cages and shafts.....	8
6. Steam and compressor plants.....	11
7. Change houses.....	12
8. Supply houses.....	12
9. Lamp house.....	13
10. Yards and material storage.....	13
11. Surface fire protection.....	14
12. Miscellaneous surface conditions.....	16
Mining methods, conditions, and equipment.....	18
13. Timbering.....	18
14. Explosives and blasting.....	19
15. Ventilation.....	30
16. Hand loading.....	32
17. Surface haulage.....	34
18. Underground haulage.....	37
19. Electricity.....	41
20. Machinery and safety appliances in connection therewith (surface and underground).....	47
21. Fire protection underground.....	51
22. Miscellaneous hazards.....	52
General safety conditions.....	54
23. Supervision.....	54
24. Safety organization.....	55
25. Safety rules and standards.....	56
26. First aid and mine rescue.....	56

^{1/} The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7387."

INTRODUCTION

While investigating prevention of sabotage and maintenance of production of essential war minerals, engineers of the Bureau of Mines visited more than 1,400 metal and nonmetallic mines, quarries, and open pits in all parts of the United States.

The need for uniform safety practices is indicated by the fact that during 1938-1940, inclusive, the Western Safety Conference, under the sponsorship of the California Department of Industrial Relations, undertook the preparation of a set of standard safety regulations for the 15 participating political subdivisions. The membership of these political subdivisions is comprised of representation from Alaska, Arizona, British Columbia, California, Colorado, Hawaii, Idaho, Lower California, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming. For the guidance of its own engineers, the Bureau of Mines found it necessary to prepare a set of safety practices that could be used uniformly throughout the United States. These safety practices were compiled from State mining regulations, mining company safety rules, and the experience of Bureau of Mines engineers for more than 3 decades, and represent the best safety practices of the Nation's mineral industry.

The purpose of this publication is to make safety practices available for the non-coal branches of the mineral industry, with the hope that they may assist in reducing accident occurrence. The Bureau will welcome questions and suggestions regarding these practices in order that changes may be made as necessary.

Where the adoption of any practice would not materially increase the safety of employees or would work undue hardship on the operator, the Bureau does not recommend such adoption.

SURFACE CONDITIONS

1. Mills and Metallurgical Plants

Mills and metallurgical plants differ widely in their equipment and processes. Safety rules should be formulated for each department of each plant, and the employees should be required to familiarize themselves with such rules.

(1) Men should not be allowed to work above a crusher except when using a safety belt.

(2) Employees should not be permitted to enter a fine-ore bin except when using a safety belt. A second employee should be required to be on top of the bin, ready to assist the first employee to climb out of the bin in an emergency.

(3) Respirators should be used in dusty atmospheres. If gas or fumes are present, proper respiratory protection should be used.

- (4) Goggles should be worn when pouring hot metal, punching tuyeres, working in acid or sludge, riveting, chipping, or in any work that may be hazardous for the eyes.
- (5) Woolen or fire-resistant clothes should be worn around furnaces and fires, as they are not readily set afire.
- (6) Asbestos mittens or asbestos gloves should be worn when punching tuyeres.
- (7) Rubber gloves and rubber boots should be worn when working in acid or sludge, and emergency shower baths should be available.
- (8) Employees should never stand in front of a charge hole when punching calcines or products of calcination.
- (9) Anything that will cause the molten material to splash or explode should be avoided.
- (10) Vats for granulating molten slag should be placed a safe distance from the plant.
- (11) Men should never stand close to pots or ladles that are being filled.
- (12) Men should stand at a safe distance while wetting down hot material.
- (13) In mercury-reduction plants, men should be particular in the matter of personal cleanliness, especially before eating; smokers are in danger from inhaling tobacco smoke contaminated by mercury.
- (14) Special precautions should be taken where cyanide is used. Antidotes should be provided at convenient places in the plant with instructions for their use; employees should wear respirators when necessary, and they should wear rubber gloves when working in cyanide solutions.

2. Open Pits, Quarries, Surface Excavations

- (1) Safe means of access should be provided to all working places in any pit or quarry.
- (2) Walkways into a quarry or pit should be graded and properly guarded, where needed, with hand rails.
- (3) Ladders used as manways should be built of not less than 2- by 4-inch lumber or its equivalent. The width between stringers should not be less than 12 inches. The rungs should be spaced 12 inches apart, center to center. They should be installed on a uniform grade with the rungs not less than 3 inches from the bank, wall, or timber.
- (4) Steeply inclined and vertical ladders should have substantial platforms at least every 30 feet. The ladders should project at least 3 feet above the platforms.

(5) Man boxes or cars should be provided for hoisting and lowering men in deep pit quarries. Men should sit in the boxes or cars if the sides are less than $3\frac{1}{2}$ feet in height.

(6) Quarry banks should be examined daily for evidences of loose rock or sliding.

(7) Hard hats should be used by all employees working near the bank or in any place where falling objects might strike them.

(8) Safety belts should be worn where there is danger of slipping or falling.

(9) Men should not be allowed to work under the swinging bucket of a shovel or dragline.

(10) Overburden should be stripped back from the face of the rock for a bench width at least equal to the depth of the overburden, and the bank should be sloped throughout its entire length, but the slope angle should not be greater than 45° from the horizontal.

(11) Substantial railings should be provided at all excavations near passageways, tracks, roadways, or buildings.

(12) Baffle boards or cribs should be placed above a quarry that is on a hillside, to prevent rock or snow slides from rolling into the pit.

(13) Large racks that require drilling for reblasting should be moved, if possible, to the quarry floor and a safe distance from the quarry face before drilling.

(14) Pumps used for drainage should be in easily accessible places. They should be covered or protected by guard rails.

3. Head Frame

(1) The head frame should be high enough to allow 15 feet between the bottom of the sheave and the highest point reached by the top of the cage or bucket when men are being hoisted.

(2) The head frame should be so designed as to withstand a pull in the direction of the hoisting engine and greater than the breaking stress of the hoisting rope.

(3) A railed platform should be provided at head sheaves.

(4) The stairway or ladder leading to the sheave platform should be provided with a handrail or guards.

(5) The diameter of the sheave should be at least 40 times the diameter of the rope used for hoisting or lowering men.

(6) Sheaves should be inspected daily and kept properly lubricated. The hoisting engineer should be advised when the inspection is completed, and a record should be made of the inspection. The hoist should not be operated during inspection.

(7) The hoist should be placed, in relation to the head frame, so that the fleet angle does not exceed $1\frac{1}{2}$ degrees.

(8) Ore bins should be provided with replaceable liner plates.

(9) Where skips or buckets are used for hoisting rock, adequate protection should be provided for topmen from spillage during dumping operations.

4. Hoisting

(1) All hoists should have sufficient power to hoist the loaded, unbalanced skip, car, trip of cars, or vertically suspended load.

(2) Hoists should be equipped with brakes capable of stopping and holding the fully loaded, unbalanced cage or trip of cars at any point in the shaft or incline.

(3) Drum sides or flanges should be high enough to extend at least 4 inches above the rope at any time.

(4) An accurate and reliable indicator of the cage or trip position should be so placed as to be in constant view of the engineer.

(5) All electric hoists should be equipped with protective devices that will bring the hoist to rest within a reasonable distance upon failure of the electric power.

(6) The hoisting engine should be provided with positive overwind and overspeed devices, or a second engineer should be in attendance at all times while men are being hoisted or lowered.

(7) Hoisting engines should be so placed that the noise of other machinery will not prevent the engineer from hearing signals.

(8) Hoisting equipment should be inspected daily, and a written record should be made of such inspection.

(9) No person except the hoist engineer should be allowed in the hoist room, unless specially authorized by the management.

(10) Hoisting engineers should be physically fit and should undergo a physical examination at least annually to determine their continued fitness, and the physician's report of such examination should be kept posted.

(11) The hoisting engineer should immediately report any defects in the hoist or signal apparatus and record same daily in a logbook.

(12) The hoisting engineer should not operate the hoist unless it is in safe condition.

(13) Hoisting engineers who make any change in or adjustment of the clutches, brakes, etc., on drums, safety devices, or any part of the hoisting equipment should report such change or adjustment to the relief engineer and record it in the logbook.

(14) Before hoisting or lowering men at the beginning of a shift, or after repairs have been made in the shaft, or after blasting has been done near the shaft, the hoisting engineer should make a trial run of the empty cage or skip to ascertain whether the shaft is clear.

(15) Where climatic conditions permit, it is recommended that the hoisting engineer going off shift leave the cage or skip above the collar of the shaft.

(16) All violations of hoisting rules should be reported to the foreman.

(17) At mines where the place of employment is reached through a shaft, a hoisting engineer should be on duty at all times while men are working inside.

(18) A hoisting rope should be large enough to handle the load with the proper margin of safety as defined in wire-rope standards.

(19) At least three full laps should remain on the drum when the rope is extended to its maximum distance; the rope should make at least one full lap on the drum shaft or around a spoke of the drum (in case of a free drum), and the end should be fastened securely, preferably by means of clamps.

(20) The rope should be fastened to its load by a thimble and clamp or cable clips, or by a spelter-filled socket or other approved method.

(21) At least four cable clips should be used for wire ropes less than $\frac{3}{4}$ inch in diameter that are used for hoisting men; for larger ropes, the number of clips specified in wire-rope standards should be used. Spacing between clips should conform to approved practice.

(22) Bridle chains that serve as a secondary safety connection between the rope and the cage should be provided.

(23) Hoisting cables used to hoist or lower men should be inspected daily by the engineer or other designated competent person. Careful inspection should be made weekly by a competent person. Records should be kept of inspections.

(24) A record of each hoisting rope should be kept, showing its length of service and the tonnage hoisted by it. A rope should be replaced as soon as there is evidence of undue weakness or other conditions that indicate that the rope may fail.

(25) A rope should not be used for hoisting men

- (a) That shows more than six broken wires in any single pitch length or lay of rope.
- (b) When the wires in the crown of the strand are worn to less than 65 percent of their original diameter.
- (c) When inspection indicates a dangerous amount of corrosion or distortion.

(26) All hoisting ropes used for raising and lowering men in vertical shafts should be cut off and reconnected every 2 months, or oftener if inspection indicates that the rope is unsafe.

(27) When the rope is cut off before resocketing, the interior of the rope should be inspected carefully and a written record of the inspection should be made. At least 5 feet of rope should be cut off before resocketing.

(28) At regular intervals, every hoisting rope should be lubricated from end to end with oil or a suitable rope compound, and the date of lubrication should be recorded in the logbook.

(29) At least two independent methods of signaling should be provided in shafts, one of which should be audible.

(30) The signal code in use at the mine should be posted prominently in the engine room in easy sight of the hoisting engineer and at all places where signals are given. All signals should be in accordance with the State code.

(31) Signal devices at surface and intermediate landings should be so placed that they may be reached from the cage.

(32) Staples and clamps should be used on all bell lines approximately 50 feet apart to prevent the bell line from falling down the shaft in case it breaks.

(33) The hoisting-signal equipment should be tested at least once each day, and oftener if repairs have been made in the shaft during the off shift.

(34) Hoisting clearance on the telephone should never be accepted unless the bell cord and electric signals are out of order. In such event, the engineer must take extreme precautions to be certain that the clearance signals are understood.

(35) Mines employing cagers to control hoisting operations should not permit other employees to give signals, except in an emergency.

(36) Regular signal equipment should not be used for calling a cage. A distinctive electric buzzer is recommended for this purpose.

(37) Station signals should be given before giving signals to hoist or lower.

(38) If signals are not understood, the hoisting engineer should wait for the signals to be repeated.

(39) A cage, skip, or bucket should not be moved without proper clearance signals except in case of grave emergency.

(40) In case of emergency, the hoist man may move the cage to any station, regardless of station signals, after receiving proper release.

5. Cages and Shafts

(1) Cages in vertical or inclined shafts should be inspected at regular intervals, preferably once each week when the shaft is operating.

(2) No open hook should be used with a bucket, cage, or skip in hoisting; instead, some approved form of safety hook or shackle hook should be used.

(3) Cages used for hoisting men should be of substantial construction, kept in good repair, and provided with

(a) Adequate steel bonnets.

(b) Fully enclosed sides.

(c) Gates closed across openings when men are being hoisted or lowered.

(4) Cage safety catches that act quickly and effectively in an emergency should be provided on cages used for hoisting men; a drop test should be made at least every 2 months. A written record of the tests should be kept.

(5) The safety catches or "dogs" should be inspected weekly to see that they are well-oiled and in good working condition; if defective in any particular; the defect should be remedied promptly.

(6) The hoisting engineer must use extreme caution when hoisting or lowering men.

(7) Cages should be operated in balance when men are hoisted or lowered; counterweights should be used when only one cage is provided.

(8) The speed of the cage when hoisting or lowering men should be determined for each shift by the management and State inspector. In no instance should the hoist be run at its maximum speed when hoisting or lowering men.

(9) When men are handled, cagers should be in charge at the top and underground.

(10) Men should not be permitted to mount a cage until the man-trip signal has been given and the hoist engineer has returned the signal, indicating that it is understood.

(11) The company or the State inspector should designate the maximum number of men that will be permitted to ride on a cage or skip.

(12) Employees should be required to enter and leave the man car or cage in an orderly manner.

(13) Employees should not be permitted to get on or off a man-car or cage until it has come to a full stop. When loading or unloading, and if return signal systems are available, the hoist engineer should signal that he has stopped the cage or man car.

(14) Only one open flame should be permitted on the cage or skip during hoisting or lowering of men.

(15) Tools and loose material should not be handled on a cage or in a skip when men are being hoisted or lowered.

(16) Where multiple-deck cages are provided or service cages are hung below the skips, no person should ride below a cage or skip loaded with powder, tools, timber, or other material, except for the purpose of unloading it.

(17) To prevent anything from falling into the shaft, care should be taken when loading or unloading supplies or material from the skip, cage, or bucket.

(18) The projecting ends of tools, timber, or other material being lowered or hoisted in a shaft should be securely fastened to the hoisting rope or the upper part of the cage, skip, or bucket.

(19) Long timbers or rails suspended below a cage or skip should be securely fastened with a clevis.

(20) Timber trucks used to haul timber in inclined shafts should be securely fastened to the cage or skip.

(21) The cage or bucket should not be left at a level or landing when not in use, but should be released and raised at least 5 feet above the floor of the level.

(22) Skip-loading pockets should be equipped with loading cartridges or other suitable devices to prevent overloading of skips.

(23) Rocks from hoisting operations should be kept cleaned from shaft timbers.

(24) A substantial partition should be provided between the rock-hoisting compartments and the service-cage compartments.

(25) Spillage pockets should be installed below the lowest active level.

(26) A pillar of sufficient dimensions to provide adequate protection should be left on each side of operating shafts.

(27) Shafts should be equipped with safety gates at the top and at intermediate landings. The gates should be so constructed that materials will not go through or under them and into the shaft.

(28) At all shaft stations a run-around not be less than 7 feet high and 5 feet wide should be provided for travel.

(29) Positive stopblocks or derails should be placed at shaft landings.

(30) Rollers used on slopes or inclines should be of sufficient length, properly alined, and kept in good repair.

(31) A thorough inspection of skip and cage guides should be made at least once each week, and the inspection should be reported in the logbook.

(32) The hoisting engineer should be informed when men are working in the shaft and should be advised when the work is completed.

(33) Before proceeding with the work, men working in or adjacent to the hoisting compartment of any shaft should be protected by a bulkhead placed above the platform on which they must stand.

(34) Repair work on shaft equipment using cages or skips should be done from a platform bolted to the cage or skip with a bonnet above the platform. It is recommended that the wooden platforms be at least 3 inches thick.

(35) Men working on top of the cage should be required to wear safety belts.

(36) Shaft timbers should be cleaned of loose material above the point of shaft repair.

(37) Men working in a new shaft or deepening an old shaft should be protected by a bulkhead that will protect them from material falling down the shaft.

(38) Suitable shaft doors or other means should be provided to prevent material from falling into the shaft when a bucket is being dumped.

(39) When a shaft is being deepened, ladderways should be maintained to the bottom of the shaft. These temporary extension ladders can be made of wire, rope, or chain.

(40) In shaft sinking, the bucket should be stopped about 15 feet from the shaft bottom to await a signal from one of the crew on the bottom for further lowering.

(41) Riding on the rim of a bucket or bail or sides of a skip should be prohibited.

(42) If shaft drill holes are fired with fuse and caps, the hoisting engine should be tested by hoisting the bucket for some distance and lowering it again before the fuses are spit.

6. Steam and Compressor Plants

(1) All boilers should receive at least one internal inspection annually by an authorized inspector, and a written record of such inspection should be kept.

(2) A safety-valve escape should not discharge lower than 7 feet off the floor; preferably the discharge should be piped to the outside of the building.

(3) Safety valves should be tested frequently.

(4) Steam gages should stand at zero when the pressure is off and should show the same pressure as the safety-valve setting when the safety valve is blowing off.

(5) The water gage and passages to the gage should be kept clean.

(6) Steam valves should be opened slowly.

(7) Engineers, firemen, and other persons in authority should not make repairs of any nature on any boiler or fitting until the steam pressure has been removed.

(8) Men should never go into a boiler until all valves have been closed, the fireman in charge notified, and danger signs attached to the boiler.

(9) At least two safe means of exit from all parts of the boiler room should be available, the doors of which should open outward.

(10) A stairway or fixed ladder should be provided to give easy access to the top of boilers or runways between boilers.

(11) Compressed-air receivers should be inspected at least annually by a competent person, and a written record of such inspection should be kept.

(12) All compressed-air receivers should be protected by safety valves or relief valves to insure safe operation. The safety or relief valves should be tested every day when in use.

(13) Compressed-air receivers should be equipped with drain valves. The receiver should be blown out at least once each working day.

(14) Suitable gages should be provided for boilers and compressors (steam pressure, air pressure, water, etc.).

(15) The air intakes should be protected or placed at such points as to insure that clean, pure air enters the compressors; air filters are recommended.

(16) Where a gasoline or Diesel engine is used to drive a compressor, the pipe for exhaust gases from the engine should be placed so as to prevent the exhaust gases from entering the air intake of a compressor.

(17) When a compressor supplies air to hose masks, a temperature regulator should be provided in the air line between the compressor and the receiver.

7. Change Houses

(1) If practicable, change houses with showers and an adequate supply of hot and cold water should be provided.

(2) The change house should be

(a) Kept clean and sanitary.

(b) Provided with at least two exits.

(c) Well-illuminated.

(d) Provided with clothes lockers or hangers.

(e) Kept well heated and, if necessary, heating equipment should be guarded against contact hazard.

(f) Properly ventilated.

(3) Adequate facilities should be provided to prevent the spread of foot infection. If foot baths are used, the disinfectant should be changed daily.

(4) Sanitary toilet facilities should be provided.

(5) Open lights should be prohibited in a change house.

8. Supply Houses

(1) Materials should not be stored in such a manner as to cause a stumbling hazard.

(2) Materials should be stored in such a manner as to prevent them from falling.

(3) Carbide cans or drums should be kept covered and in a dry place.

(4) Calcium carbide in excess of 600 pounds should be kept in a suitable fireproof room or compartment.

(5) Open lights should not be permitted near open carbide containers. The use of carbide dispensers is recommended both as a fire preventive and as a safety measure.

(6) Not over 5 gallons of gasoline should be stored in a warehouse. The container should be painted red and marked "GASOLINE", and the spout and can should be provided with tight covers.

(7) Flammable materials and liquids should not be stored in the covered approaches of tunnels or adits.

(8) Oils and grease should be stored in closed containers in a building situated a safe distance from other buildings; the building should be of fire-resistant material and provided with a ventilator extending to near the floor level.

(9) The use of leak-proof oil valves is recommended. Sawdust or sand should be kept on the floor, and drip pans should be provided to catch any oil spilled when filling containers.

(10) Suitable "No Smoking" signs should be placed on all sides of the oil or gasoline storage.

(11) Gasoline should be stored in underground tanks when practicable.

(12) Gasoline storage in barrels and drums should be limited to as small amounts as possible. The gasoline barrels or drums should be stored in a locked shed or building at a safe distance from other buildings.

(13) All barrels and drums containing gasoline should be inspected frequently for leaks.

9. Lamp House

(1) Charging equipment should be guarded and protected against shock and fire hazards.

(2) When not in service, methane indicators or detectors and flame safety lamps should be placed in the custody of a competent person responsible for their maintenance and testing.

(3) The lamp house should be well-ventilated.

10. Yards and Material Storage

(1) Timbers, ties, and other mine lumber in excess of 1 day's supply should not be kept within 100 feet of any mine opening or mine fan; and all materials, including rails and scrap iron and other scrap, should be properly stored and piled so that they will not obstruct roadways, will not present stumbling hazards, and will not roll or fall.

(2) Roads, paths, and walks should be kept free from obstructions and should be well illuminated if used between sunset and sunrise.

(3) Whenever icy or slippery conditions exist, all reads, paths, and walks should be well-sanded or otherwise suitably protected.

11. Surface Fire Protection

(1) Fire protection commensurate with the value of the buildings and their contents should be provided.

(2) Fire-fighting equipment should be readily accessible, and the place housing such equipment should be marked plainly.

(3) Water lines, valves, and pipe connections on water lines and water tanks should be protected from freezing.

(4) Fire lines should be tested frequently, especially in winter, to insure that they are in proper working condition. A record should be kept of the date of each test and the conditions found by the inspector.

(5) Fire hydrants should be placed at a safe distance from buildings so that a fire could not render them useless.

(6) Fire hydrants should be standard and should fit the hose equipment of the local fire department. Adapters should be provided where necessary.

(7) Wrenches or keys for opening the water-line valves should be securely attached to the fire hydrant or placed where they are quickly accessible.

(8) Water lines in buildings should be provided with standard fire-hose connections at convenient places; the fire hose should be racked at each outlet, with the hose connected to the water line, ready for use, and the nozzle should be attached to the hose.

(9) Only fireproof buildings should be permitted to adjoin mine shafts, tunnels, or adits.

(10) All buildings within a radius of 100 feet from any mine opening should be of fireproof or fire-resistant construction.

(11) Fire doors should be erected at mine openings or other effective points so that smoke or fire from outside sources may not endanger men working underground.

(12) Buildings not on tight fire-resisting foundations should be banked with dirt to reduce the fire hazard from lighted cigarettes or other causes.

(13) Blacksmith shops should not be placed in the area enclosed by snow sheds or other shelters covering the approach to tunnels or adits. Provision should be made for adequate ventilation of the shop.

(14) The area immediately surrounding a substation should be kept free from grass, weeds, and underbrush, which might be set on fire accidentally or intentionally.

(15) Transformers placed inside a building should be adequately guarded with fireproof or fire-resisting materials that will prevent fire from spreading in the event the transformer oil is ignited.

(16) If surface transformers containing flammable oil are installed where they present a fire hazard (near mine openings and in or near combustible buildings), means should be provided to drain or confine the oil in event of rupture of the transformer casing.

(17) Domed-bottom pails should be hung close to water barrels provided for fire protection.

(18) Soda-acid fire extinguishers for use on fires in ordinary combustibles, such as paper, wood, rubbish, etc., should be provided in buildings; they should be protected against freezing temperatures.

(19) Foam fire extinguishers should be provided where flammable liquids are stored or handled; they should be protected against freezing temperatures.

(20) Carbon tetrachloride, carbon dioxide, or dry-chemical type fire extinguishers should be provided for electrical fires, and should be placed where they are easily accessible.

(21) Carbon tetrachloride extinguishers should not be used in a confined place.

(22) Soda-acid or foam-type extinguishers should not be used on an electrical fire.

(23) Water should not be used to extinguish an electrical fire unless a fog nozzle is provided.

(24) Carbon tetrachloride or carbon dioxide fire extinguishers should be carried on electric locomotives at all times.

(25) Fire-fighting equipment, other than water lines, should be inspected and tested at least every 6 months, and written records should be kept of each inspection.

(26) Fire-fighting equipment should not be used for any purpose but that for which it is intended.

(27) A distinctive fire alarm should be provided.

(28) Fire-fighting organizations should be maintained on each shift, and fire drills should be held frequently.

(29) Heating equipment should be installed in such a manner that fire cannot be caused even if overheating occurs. Suitable spark arrestors should be installed where needed.

(30) Blacksmith fires should be quenched with water before attendants leave the shop unattended for protracted periods.

(31) Blacksmith shops and surrounding area should be carefully inspected for smoldering fires, before going off shift.

(32) Oxyacetylene, oxyhydrogen, or electric welding should not be started until after adequate protection from fire has been provided. A suitable fire extinguisher should be a part of portable welding units.

(33) A careful fire inspection should be made after using oxyacetylene, oxyhydrogen, or electric-welding equipment, particularly if the equipment is used in or immediately above a shaft.

(34) "Good housekeeping" is essential to good fire protection and should be enforced at all times.

(35) Flammable materials should not be permitted to accumulate in or around any building.

(36) Smoking should be prohibited in all buildings in which flammable liquids are stored or dispensed.

(37) Grease and lubricating compounds used on machinery should not be allowed to accumulate on the floor or compartment housing the machinery.

(38) Tightly covered metal receptacles should be provided for oily waste and rags.

(39) Gasoline should not be used for cleaning.

(40) Gasoline, oil, or kerosene should not be used for starting fires.

(41) Gasoline cans kept on power equipment should be painted red and marked "Gasoline." The cans should be kept tightly capped at all times when not in use and should be inspected frequently for leaks.

(42) Carbide cans should be washed out immediately after emptying. While washing empty carbide cans, smoking or wearing open lights should be prohibited.

(43) A screened container should be provided to screen the unused carbide from miners' lamps. The screened carbide should fall into running water if practicable. The screened container should not be placed near combustible material or liquids.

12. Miscellaneous Surface Conditions

(1) Good housekeeping should be practiced.

(2) Surface buildings should be well-lighted and well-heated, if lighting and heating are necessary.

- (3) Surface stairways should not be set on an angle of more than 45° with the horizontal.
- (4) Stairs, platforms, and dangerous walks should be provided with toe boards and rails or fencing.
- (5) The treads of stairways should present a minimum slipping hazard and be of uniform construction and spacing and kept in good repair.
- (6) Clearance over stairways should be at least $6\frac{1}{2}$ feet.
- (7) Ladders should be well-built and in safe condition for use at all times. Safety feet are recommended for all portable ladders.
- (8) Permanent ladders should be provided with guards, if necessary.
- (9) A ladder should not be allowed to incline backwards under any circumstances.
- (10) Both hands should be used when climbing a ladder. Materials should be raised or lowered with a rope.
- (11) Men working at high elevations, from which they are liable to fall, should be required to wear safety belts attached to firmly fastened safety lines.
- (12) Men subject to dizziness should not work in or on high places.
- (13) Employees who work on a scaffold of any description should personally see that the supports are properly erected and in safe condition.
- (14) The floor boards of stages, platforms, and scaffolds should not be less than 2 inches thick, and preferably they should be 3 inches or more in thickness. The floor boards should be of sound lumber and laid tightly.
- (15) Temporary scaffolds should be torn down and material should be piled as soon as a job is completed.
- (16) Tools, drills, drill steel, or other material should not be left on scaffolds at the end of the shift.
- (17) Materials of any kind should not be thrown down to a floor or platform until after a warning has been given, and all persons are in safe places.
- (18) Unsafe roofs, floors, or other areas or regions should be closed off and warning should be posted.
- (19) Temporary openings into which people may walk should be closely guarded or covered.
- (20) Warning lights should be placed at all holes and excavations at night.

(21) Goggles should be used at all times when there is danger of flying particles that might injure the eyes.

(22) Respirators should be worn by men working in dust. If fumes or gas are present, suitable respiratory protection should be used.

(23) The use of hard-toed shoes by all employees is recommended.

(24) Men should not walk under suspended loads.

(25) Boards with protruding nails should be removed to a safe place, or the protruding nails should be removed or turned down.

(26) Men should be prohibited from having liquor on the job and from coming on the job under the influence of liquor.

(27) Horseplay or pranks should not be allowed.

(28) Assistance should be obtained when carrying heavy equipment or materials. The leg muscles should be used for lifting, keeping the back straight and shoulders higher than the hips.

(29) Notice should be given to fellow workmen before materials being carried by more than one person are released.

MINING METHODS, CONDITIONS, AND EQUIPMENT

13. Timbering

(1) Defective timber should not be used. The safety of the men depends on proper timbering of working places.

(2) Loose or drummy rock should be barred down or timbered.

(3) Wedges and blocks used in timbering should be kept tight at all times.

(4) Unblocked timber should be supported with nailed braces until it can be blocked.

(5) Booms or spiling projecting out ahead of the last set of timber should be used to protect men from loose or dangerous ground.

(6) Timbermen should not work near an open chute unless absolutely necessary, in which case a rope and safety belt should be used.

(7) When cleaning for a timber footing, the timbermen should be sure the muck pile is broken down enough to prevent large rocks from rolling down.

(8) Nails that project from a plank or timber should be pulled out or driven flush with the surface of the timber.

- (9) Platforms and scaffolds should be made safe before men work on them.
- (10) Tools and timber should not be thrown down manways.
- (11) Tools should be securely lashed before being hoisted or lowered in a manway.
- (12) Before hoisting or lowering materials in a manway care should be taken that no one is in the manway.
- (13) Riding upon a timber skip in a winze or raise should be forbidden.

14. Explosives and Blasting

Magazine - Surface

- (1) Surface explosives-storage magazines should be
 - (a) Constructed of incombustible material or covered with fire-resistant material and be reasonably bulletproof.
 - (b) Placed in accordance with the American Table of Distances insofar as feasible and be not less than 200 feet from any mine opening or vital structure.
 - (c) Provided with suitable danger signs nearby.
 - (d) Provided with proper ventilators, effectively screened.
 - (e) Provided with proper doors.
 - (f) Kept locked securely at all times when not in use.
 - (g) Unheated, except in a manner approved by the Bureau of Mines or other competent authority, to suit extreme cold-weather conditions.
- (2) The interior of magazines should be kept clean and dry at all times.
- (3) The floors of explosives magazines should be of nonsparking material, preferably of wood, with no exposed metal.
- (4) If the explosives magazine is illuminated electrically, the lamps should have explosion-proof globes, the switch should be located outside the building, and wiring should be inclosed in rigid conduits.
- (5) The area surrounding the magazine for not less than 25 feet, preferably 50 feet, in all directions should be kept free of rubbish, dry grass, or other combustible material, preferably, this area should be covered with some material to prevent the growth of grass, brush, and weeds.

(6) Explosives should be stored in such manner as to insure issuance of the oldest stock first. Cases of explosives should be stored with the top side up, except when periodic turning of cases of explosives is required as recommended by the manufacturers. Cases should not be stored in such a manner that the cartridges stand on end.

(7) Deteriorated or damaged explosives and detonators should be destroyed. Explosives and detonators should be destroyed only by a person who is experienced in this work, preferably a technical representative of a manufacturer of explosives.

(8) Detonators should be stored in a separate magazine of incombustible material or covered with fire-resistant material and located not less than 100 feet, unbarricaded, or 50 feet, barricaded, from a magazine containing explosives.

(9) Detonators, tools, and materials other than explosives should not be stored in an explosives magazine; however, this does not prevent the storing of safety fuse or detonating fuse in any explosives or detonator magazine.

(10) Fuse should be stored in a cool, dry place and should never be allowed to become overheated.

(11) Fuse should not be allowed to come in contact with oils, paints, kerosene, gasoline, distillates, or similar solvents. (These substances may penetrate the powder train and cause it to fail completely or to burn at an irregular speed.)

(12) The older fuse should be used first, before new stock. (Old fuse sometimes becomes brittle.)

(13) Unauthorized persons should not be permitted access to any magazine.

Magazine- Underground

(14) Underground explosives-storage magazines should be

- (a) Placed in an area removed from fire hazards.
- (b) At least 200 feet from main shaft or active working.
- (c) In a separate offset, preferably in an abandoned section.
- (d) At least 25 feet from haulageways or travelways, if feasible.
- (e) Provided with signs plainly marked "EXPLOSIVES - DANGER" at the entrance to the drift in which the magazine is situated and on the magazine itself.
- (f) Provided with proper ventilators, well-screened.
- (g) Kept locked at all times except when attendant is present.

(15) Magazines should be kept dry and should be properly drained.

(16) Lighting should be indirect, or by means of permissible electric storage-battery lamps, or by some other electrical system approved by the Bureau of Mines.

(17) Detonator magazines should not be situated nearer than 25 feet from any explosives magazine.

(18) The detonator magazine may be used as a fuse-cutting station, when situated in a safe place.

(19) Hardwood or plastic tools should be used to open wooden cases of explosives. Never use steel or iron tools.

(20) Waste paper, sawdust, used empty boxes or other containers, or packing material should not be allowed to accumulate in or near storage or distributing magazines.

(21) Smoking should be prohibited in or around magazines.

(22) Open lights or other flames should not be permitted in or around magazines.

(23) Blasting should not be permitted within 200 feet of an underground magazine.

(24) Explosives or detonators (preferably not over 1 day's supply) may be stored in separate, locked, box-type magazines situated a safe distance from working faces.

Surface Transportation of Explosives

(25) Vehicles used in surface transportation of explosives should be constructed substantially, have tight bodies with no internally exposed metal, and kept in good working order. Open vehicles should be provided with tarpaulins. The ends and sides of the vehicles should be high enough to prevent containers from falling off.

(26) Vehicles should not carry blasting caps or detonators while carrying explosives.

(27) Vehicles carrying explosives should ~~not~~ carry metal, metal tools, oils, matches, firearms, acids, or flammable materials of any description. This does not apply to truck repair tools carried in a proper receptacle.

(28) Explosives should be transported on streets or highways only during daylight hours, if feasible. Streets with congested traffic should be avoided.

(29) Motor vehicles used to transport explosives should be required to conform to the speed limits provided by the traffic laws.

(30) State or other regulations as to marking vehicles used to transport explosives should be followed. If no laws or regulations are in effect, any such vehicle should be placarded on each side and the rear with the word EXPLOSIVES in letters not less than 3 inches high, or should display a red flag with the word DANGER in white letters not less than 6 inches high.

(31) Unauthorized persons should not be permitted to ride on vehicles transporting explosives, and the driver and helper should neither smoke nor carry matches or lighters.

(32) Vehicles carrying explosives should not be taken into a garage for repairs or for other purposes.

(33) A vehicle containing explosives should never be left standing or unloaded without first stopping the motor and setting the brakes securely. Explosives cases should never be left immediately back of the exhaust, as a spark may start a fire or cause an explosion.

(34) Explosives or detonators should never be left unattended except when they are placed in a magazine and the magazine is locked.

(35) Containers of explosives or detonators should always be lifted and set down carefully, never slid over one another or dropped from one elevation to another.

Underground Transportation of Explosives

(36) Explosives or detonators should not be transported on or with the man-trip.

(37) Explosives should not be carried on an electric locomotive.

(38) Explosives and detonators should be transported in separate insulated cars in those mines in which haulage is by trolley locomotive.

(39) In other mines, explosives and detonators may be transported in ordinary mine cars when in the original unopened containers or in separate insulated carriers or compartments.

(40) Cars transporting explosives should be pulled and not pushed by locomotives.

(41) Only the attendants should be permitted to ride with explosives or detonators when being transported in a shaft, slope, or other underground workings.

(42) Explosives should be taken into the mine when the regular shifts are out of the mine and this is feasible.

(43) Explosives should be handled promptly without undue delays while in transit.

(44) Explosives and detonators, when carried by employees, should be placed in separate insulated carriers or containers.

(45) Explosives should not be taken to a working place until drilling has been completed and all equipment has been moved a safe distance from the face.

General Use of Explosives

(46) Explosives (Fume class 2 and 3) that produce more than 0.16 cubic foot of poisonous gases per $1\frac{1}{4}$ - by 8-inch stick should not be used underground. If explosives that produce more than 0.16 cubic foot of poisonous gases per stick are used, special precautions should be taken to insure adequate ventilation.

(47) Blasting crews should be composed only of careful, experienced men, who understand the hazards of explosives. The number of men used in loading operations should be kept at a minimum.

(48) Blasting crews should be organized carefully, and each man should be assigned to definite tasks to prevent confusion.

(49) When holes are being charged, no person other than those designated to load should be permitted to work where there is possible danger of a premature explosion.

(50) Dynamite thought to be frozen should not be used.

(51) Smoking should be prohibited while handling explosives.

(52) Electric flashlights with insulated bodies or approved battery cap lights should be used in loading blasting holes.

(53) If open-flame lamps are in use, they should be kept at a safe distance during loading of blasting holes.

(54) Accurate daily records of explosives should be kept.

(55) Primed cartridges (primers) for immediate use may be prepared and transported in separate insulated carriers, containers, or compartments. They should not be removed from the insulated carrier until ready for placement.

(56) Primers should be prepared as recommended by the various explosives-manufacturing companies. The electric detonator or fuse and cap should be fastened securely to the primer cartridge.

(57) Packages or containers of explosives should not be thrown or dropped while being loaded, unloaded, or otherwise handled, but should be carefully deposited and stored or placed in such a manner as to prevent the packages or containers from sliding, falling, or being otherwise displaced.

(58) Only wooden tamping bars should be used, and tamping should be done by pressure on the bar. Do not "ram" the tamping bar. Metal tamping bars should not be used.

(59) Stemming should be used in all drill holes. It is recommended that the stemming be in cartridge form before inserting it into the hole.

(60) All unused explosives from blasting should be returned at once to the magazine.

(61) All approaches to the vicinity of the blasting should be guarded by responsible employees so as to prevent anyone from walking into danger unknowingly.

(62) Distinctive signals should be provided to give adequate warning before a blast. The "All Clear" signal should be given when it is safe to return.

(63) Special precautions must be taken when two headings are about to connect. When the faces of the two headings are within 20 feet of each other, the men should be removed from both headings at the time of the blasting, and the approaches to both headings should be guarded.

(64) When blasting several faces, as on a level, those farthest from the shaft should be blasted first. The others will be blasted in turn, and the face nearest the shaft will be the last.

Fuse Blasting

(65) At least two men should be present when spitting holes.

(66) The minimum length of fuse should be designated by the company management, but no fuse should be less than 30 inches in length.

(67) Burning rate of fuse should be tested frequently and should be posted on a bulletin board and at the fuse-cutting station.

(68) The length of fuse for rounds should be that required by State law; or, in the absence of State law, it should be determined by the management. The following fuse lengths are recommended:

Number of holes	Length of fuse	
	Burning rate: 40 seconds per foot	Burning time
4-10	6 ft. 0 in.	4 min.
11-15	7 ft. 0 in.	4 min. 40 sec.
16-20	8 ft. 0 in.	5 min. 20 sec.

and correspondingly longer fuse for additional holes.

(69) An effective type of lighter should be used to light fuses.

(70) The number of holes that can be blasted at any one time should be determined by the management, and the rule should be strictly enforced. Normally, not over 15 fuses should be spit by each blaster.

(71) Lighting of fuse before placing the primer in a drill hole should be strictly prohibited.

(72) Crimpers should be used for crimping caps. Never crimp caps with a knife or with the teeth.

(73) In wet work, the cap crimp should be waterproofed.

(74) Copper or wooden pins or skewers should be used for punching holes in the primer cartridges.

(75) Blasting fuse should not be kinked sharply, bent, or handled roughly; such treatment may result in a missed hole.

Electrical Blasting

(76) Drill holes in raises over 50 feet vertically above the level or side opening should be fired electrically.

(77) Drill holes in shafts or winzes should be fired electrically.

(78) The use of electric detonators for block holes is recommended when it is practicable to use them.

(79) Electric power should be cut off equipment at or near a face before explosives are taken to such face, during charging, and between charging and firing of shots.

(80) All electric detonators should be tested with a galvanometer before the primers are made.

(81) The leg wires of the detonators should be kept short-circuited at all times until ready to be connected for blasting.

(82) Lead wires should be protected at all times from possible stray currents or from other possible sources of electricity. The ends of the lead wires should be kept short-circuited at all times until the shot is ready for blasting.

(83) The correct procedure in firing blasts electrically is .

(a) Connect detonator wires.

(b) Connect lead wires to the detonator wire.

(c) Unreel the lead wire as the blaster retreats towards the safety switch.

(d) Connect lead wire to the safety switch.

(84) When large blasts are detonated with electric detonators, they should be fired from a power circuit of ample capacity.

(85) When blasting is from power circuits, a safety switch should be installed at a safe distance from the blast.

(86) The safety switch and the blasting switch should be encased in boxes and arranged so that the covers cannot be closed with the switches in a closed position; switch boxes should be kept with the switches locked in an open position, except when about to blast.

(87) Keys to the "master" switch should be entrusted only to the person designated to fire the shot.

(88) If the charge is to be fired with a blasting machine, the holes should be connected in series, as recommended by the manufacturers.

(89) The number of detonators connected in series should not exceed the rated capacity of the blasting machine.

(90) Electric detonators of different makes should not be used in the same round.

Small Drill-Hole Blasting

(91) New holes should not be started in the bottoms or "boots" of old holes.

(92) Drill holes should be cleaned thoroughly with a scraper or blown out with compressed air before charging.

(93) Block-holing should be used in secondary blasting whenever possible. The practice of "mud-capping" is not recommended, except in emergency or under special circumstances.

(94) Two "mud-caps" or "dobies" should not be placed on one rock unless detonated electrically.

(95) The miner should be sure the working place is free of gas before entering after blasting. Compressed air or other ventilating equipment can be used for ventilation.

(96) The face should be inspected carefully for missed holes after each blast. The face should be washed with a water spray as an aid in detecting missed holes.

(97) Misfires occurring at the end of a shift should be reported to company officials and to miners who will work in that place during the next shift.

(98) Do not return to a misfire until at least 30 minutes have elapsed, or such longer time as the State law requires.

(99) If a misfire occurs when an electric detonator is used, test the detonator with a circuit tester, and if it shows a circuit, connect the wires in the usual way and fire.

(100) Employees should not be permitted to remove or attempt to remove explosives from a missed hole. A missed hole should be handled under the direction of the foreman or other person assigned to this task by company officials.

(101) The following suggested method of handling misfires applies only in those States that do not have laws requiring a different method of reblasting missed holes.

- (a) Do not use a scraper to remove stemming from a hole that has missed.
- (b) Missed holes having only 12 to 15 inches of stemming can sometimes be detonated without removing the stemming by using a fresh primer in the hole.
- (c) Wash enough stemming from the hole to place a fresh primer near the unexploded charge. Use a stiff rubber hose and a fairly strong jet of water. This will ruin the explosives unless they are water-resistant.
- (d) Blow out the stemming with compressed air. Use a stiff rubber hose equipped with a regulator valve within reach of the operator; the regular steel blowpipe should not be used, even when tipped with rubber.

(102) Drilling should be stopped in any working place where missed or cut-off holes are found, and drilling should not be resumed until the explosives are either blasted or washed out.

Well-Drill Holes

(103) The condition of each hole should be recorded and noted on the loading plant. The holes should be proved with a "dolly" before loading. A small mirror can be used for visual inspection of the hole.

(104) Tamping equipment should be checked, and ropes should be inspected before being used. Dollys should not be permitted to become badly worn before being replaced with new ones.

(105) Tamping dollys should be checked for exposed metal parts.

(106) Detonating fuse is generally regarded as the safest method of detonating well-drill holes.

(107) Great care should be taken to make the connections as recommended by the manufacturers.

(108) Reels should be provided for reeling Cordeau or Primacord into the hole, or other suitable means should be made ready before loading starts.

(109) If electric detonators are used in well-drill holes, precautions should be taken not to damage the insulation of the wires.

(110) Sufficient stemming or tamping material should be screened and placed by each hole before delivery of any explosives.

(111) Holes should never be loaded while coal-burning locomotives, shovels, or other equipment are working in the vicinity.

(112) Explosives should never be transported, handled, or used during an electrical storm.

(113) If explosives are delivered by truck, only one truck load should be permitted at or near the loading operations. Other loaded trucks should wait in a safe place away from the loading operations, or their time of arrival should be regulated to allow sufficient time to load the explosives from each truck into the holes before the next truck arrives.

(114) Explosives should be distributed to the holes farthest from the truck road first, to avoid driving among piles of explosives. Trucks should remain at a safe distance from holes that have been or are being loaded.

(115) When explosives for a blast are delivered to the foot of a bank and are carried to the holes by men, the same care should be taken to avoid having excessively large amounts of explosives in one area.

(116) No detonator, blasting caps, or other explosive material foreign to the proper loading and detonating of the blast should be allowed in the vicinity in which the loading is being done.

(117) When loading a long line of holes, a hole should be skipped at intervals, and the gaps should be filled in when loading is completed. The gaps will help prevent the propagation of the entire shot in the event of a premature explosion.

(118) Large cartridges of dynamite, such as are commonly used in blasting well-drill holes, should not be dropped into a hole, unless the hole is free from obstructions for its entire length.

(119) Large cartridges of dynamite that have wedged in a hole should not be tamped with a dolly. A spear-shaped tamping block, such as recommended by the manufacturing companies, should be used to dislodge the cartridge.

(120) A free-running powder or dynamite cut in small pieces should be used to load ragged holes or holes partly closed by an obstruction that cannot be removed.

(121) Black powder or bag powder, when used in well-drill holes, should be poured from the container through a copper funnel having high sides and a closed top. An opening large enough for convenient handling of powder containers should be on one side. This gives protection from chance sparks that may come in contact with the explosives.

(122) Stemming should be placed in each hole as soon as loading of the explosives has been completed, care being taken to protect the detonating fuse or lead wires from damage.

(123) When the blasting signal is given, shelter should be taken immediately at a safe distance but under a suitable roof constructed of at least 2-inch oak boards. Men should remain under the shelter until the signal has been given that blasting is over.

(124) A misfired well-drill hole should be handled as recommended by the Institute of Makers of Explosives.

(125) Drill holes that have been sprung or chambered should be allowed to cool before explosives are loaded; when large springing charges are fired, holes should be allowed to cool for 24 hours.

(126) Power lines adjacent to blasting operations should have the power cut off before blasting.

Gopher-Hole Blasting.

(127) Explosive charges should be pushed to the back of the hole with a wooden pole, care being taken not to block the hole.

(128) The primer cartridge should be loaded after all other explosives have been placed in position.

(129) Precaution should be taken when placing stemming in the hole, especially if loose explosives are on the bottom of the hole.

Tunnel or Coyote-Hole Blasting.

(130) Employees should be prohibited from wearing shoes having steel plates or other metal that may cause a spark.

(131) Precaution should be taken in transporting explosives to the loading operations:

- (a) If explosives containers are carried by men, the roadway should be kept free from obstructions that might be a stumbling hazard.
- (b) If explosives containers are passed from one man to the next, the men should be cautioned not to drop the explosives.
- (c) If explosives containers are slid (on board slides) to the loading operation, inspection should be made for protruding nails.

- (d) Only copper or brass nails should be used in constructing the plank slide.
- (e) If wheelbarrows are used to carry explosives, the wheel should be of nonsparking material.
- (f) If power trucks are used to carry explosives, the wheels should be of nonsparking material.

(132) Explosives should not be removed from the containers, and the containers should be piled compactly.

(133) Employees should not be permitted to eat their lunches inside the blasting tunnel or in front of the area being loaded.

(134) The following precautions should be taken when using detonating fuse:

- (a) The detonating fuse should be placed in slotted wooden boxes or troughs with wooden tops fastened with copper or brass nails.
- (b) The detonating fuse should be taken from the wing entrance to the end of the blast and looped back through the units of the explosives charge.

(135) The following precautions should be taken when blasting electrically:

- (a) When a box of dynamite is used as a primer, it should be prepared outside the tunnel and never at the loading site. The detonator wires should be brought outside the box through a notch in the side of the box, and the cover should be placed firmly on the box.
- (b) Lead wires should be installed prior to loading. The lead wires can be passed through ring pins in the roof or carried in slotted wooden boxes or troughs with a wooden cover. Copper or brass nails should be used to fasten covers.
- (c) Circuits should be tested at least every 10 feet when stemming is placed in the crosscuts.

15. Ventilation

(1) All mines should be ventilated to insure fresh air in all active sections of underground workings, and inactive sections should be fenced or sealed.

(2) The main-intake and main-return air currents in mines should be in separate shafts, slopes, or drifts.

(3) Airways should be kept clear to permit free passage of air; this includes nonhaulage air courses as well as those utilized for haulage or as manways.

(4) It is desirable that haulage and hoisting openings and main and intermediate haulageways be on intake air.

(5) Ventilating currents should be controlled by mechanical means, and this is especially important where underground fire hazards are prevalent.

(6) Mechanical ventilation should be provided, where necessary, to maintain the following conditions:

- (a) At least 20 percent oxygen.
- (b) Not more than 0.5 percent carbon dioxide.
- (c) No harmful amount of dust or poisonous gases.
- (d) A velocity of 100 linear feet per minute where the relative humidity is 85 percent or more and the dry-bulb temperature is between 75° and 85° F.
- (e) A velocity of 400 linear feet per minute where the relative humidity is 85 percent or more and the dry bulb temperature is more than 85°.

(7) An air velocity of at least 30 feet per minute should be maintained in working places after blasting; or if this is not feasible, sufficient air movement should be provided to dilute or to remove blasting fumes with as little delay as possible.

(8) It is desirable that main fans be located above ground; however, this cannot always be done in metal mines.

(9) Main fans should be

- (a) So placed that the return air from the mine cannot be drawn into the intake openings.
- (b) Installed to permit prompt reversal of direction of air flow.
- (c) In a noncombustible housing. If present installations do not meet this recommendation, such installations should be made fire-resistant.
- (d) Provided with noncombustible air ducts. If present ducts do not meet this recommendation, they should be made fire-resistant.
- (e) Offset from the direct line of the mine workings; the offset distance should be at least 25 feet.

- (f) Provided with pressure-recording gage or water gage.
- (g) Inspected daily.
- (h) Kept free of combustible material for at least 100 feet in all directions.

(10) Underground booster fans should be installed so as to prevent recirculation of air.

(11) The volume of the intake air passing an auxiliary blower-fan installation underground should be at least $1\frac{1}{2}$ times the volume of the air circulated by the blower fan.

(12) Where doors are used to course the air, they should be:

- (a) Self-closing.
- (b) Hung so that they swing to the clearance side.
- (c) Installed so as to remain closed in the event the ventilating current is reversed in an emergency.

(13) Changes in ventilation that may affect the safety of the men should be made when the mine is idle and no men are in the mine except those engaged in changing the ventilation.

(14) In every sealed area, one or more stoppings should be fitted with a pipe or valve to allow sampling the air behind the seals and also to provide a means by which existing hydrostatic pressure can be determined.

16. Hand Loading

- (1) The working place should be ventilated before starting work.
- (2) Employees should be warned to go to a fresh-air source if affected by gas.
- (3) Miners should be forbidden to work under loose ground.
- (4) The working place should be inspected for loose rock before work is started. Loose rock should be barred down.
- (5) Care should be taken not to stand under that portion of the back that is being sounded for loose ground. Stand well away from any rock that is being barred down.
- (6) A pick should not be used to take down loose rock; a bar of sufficient length is safer.
- (7) The working place should be clean, and a clear way should be maintained for a quick retreat.

(8) The sides of the working place should be trimmed of loose rock as they are uncovered.

(9) Care should be taken to watch for loose explosives and detonators in the muck pile.

(10) Explosives recovered from the muck pile should be returned to the magazine immediately.

(11) Muck piles should be wet down before loading in order to diminish the dust, to remove the hazards from oxides of nitrogen, and to entrain any carbon monoxide present in the muck pile so that it will be liberated slowly during mucking operations.

(12) Large rock on the muck pile should be rolled down from the pile.

(13) Rocks that are too large for one man to handle easily should be broken. Lifting large rocks frequently causes accidents.

(14) The face of the muck pile should be broken down to prevent rocks from rolling down the pile during shoveling.

(15) All chutes near the working place should be covered or guarded.

(16) A safety belt and rope should be used when mucking at the edge of an open chute. These chutes should be covered except while dumping muck.

(17) Guards should be placed around a dump chute when tramming with a wheelbarrow.

(18) Side dumping a wheelbarrow in a chute is preferable to end dumping, if practicable.

(19) Grizzlies should be kept covered at all times except when passing rock through them.

(20) Men working on grizzlies should wear safety belts fastened to rope that is firmly fastened to the wall or backing. The purpose of this requirement is to prevent a man from falling through the grizzle and to prevent his standing directly in the path of falling rock.

(21) If a grizzly is under a chute or finger raise, employees should not be permitted to climb over them if the ore is hung up.

(22) Any boulder or slab that is to be drilled or struck with a hammer should be examined closely for explosives.

(23) Men should never stand on loose ore or rock over a raise; it may drop at any time and draw them in. If work must be done above areas that are likely to be drawn down, the muck should be covered with lagging so as to provide a safe platform.

(24) Men working with picks, shovels, etc., should be spaced far enough apart to avoid the possibility of striking one another.

17. Surface Haulage

(1) Track and roadbed should be maintained in good condition.

(2) Adequate clearances should be maintained at all times. If this is impracticable, warning signs should be placed conspicuously, and employees should be warned.

(3) All frogs, switches, and guard rails should be guarded so as to reduce the hazard of a man's foot being caught while walking on the track.

(4) All switches should have the thrown bar parallel to the track.

(5) Switch throws should be so installed as to provide adequate clearance for switchmen.

(6) The rod extending from the bridle bar to the throw should be covered or the stumbling hazard should otherwise be minimized.

(7) Derail devices should be installed where necessary on all side tracks on the surface near junctions with main lines.

(8) A safety switch or derailing device should be placed on all inclined tracks to prevent a runaway car from going back into the mine or pit.

(9) Cars left on a grade should always be well-blocked and have the hand brake set tight. If the grade leads into a place where men are working, a derailer or derail switch should be provided.

(10) Dead-end tracks should have bumping blocks or the equivalent to prevent cars from running off the end of the tracks.

(11) Repair tracks should be properly flagged when men are working on equipment.

(12) Outside planes or inclines should have

(a) A positive stopblock at the top.

(b) A derail near the top.

(c) A derail near the bottom.

(13) Where surface operations require that many persons pass over the haulageway, a warning signal should be installed or an overhead walkway or underpass provided.

(14) Crossings on the surface should be guarded while cars are being moved.

- (15) Employees should be prohibited from sitting on tracks or under cars.
- (16) Employees should be prohibited from climbing over or crawling under cars to cross tracks.
- (17) Locomotives should be equipped with a bell or whistle, or both, capable of giving a loud and clear warning signal.
- (18) Locomotives should be equipped with front and rear lights for night operations.
- (19) Locomotives should carry warning lights and clearance lights from sunset to sunrise.
- (20) All locomotives should have footboards at each end. The footboards should be equipped with toeboards. The grab irons and handrails should be well-maintained at all times.
- (21) Locomotives should carry rerailers at all times, as well as spike hammers, spike bars, a track gage, and spikes.
- (22) Safety latches should be provided on electric locomotives to hold trolley poles or pantagraphs away from the trolley wires.
- (23) No one except the train crew and persons authorized by the management should be permitted to ride on or in a locomotive or train.
- (24) When men are transported in cars on outside planes or inclines.
 - (a) Special provision should be made, in addition to coupling, to insure against accident should the rope or the coupling of any car break or become detached, or should the drawbar of any car break.
 - (b) The cars should be provided with level seats and hand holds.
 - (c) No tools, explosives, or other material should be carried in cars with men.
- (25) The engineer or motorman should be made responsible for the safe operation of the locomotive.
- (26) Locomotives should not be run over tracks where dirt or other material strikes the footboards.
- (27) "Poling" or moving a car on another track with a pole should be done only in emergency. When "poling", the pole should be placed against the car, the engine brought to the other end of the pole, and the bumper held tightly against the pole. DO NOT PUSH THE CAR UNTIL ALL PERSONS ARE IN A SAFE PLACE.
- (28) Flying switches should be prohibited.

(29) Locomotives should be stopped and trolley removed from the trolley wire during severe electrical storms.

(30) Cars should be stopped to line up couplings. Couplings should never be lined up with hand or foot while cars are moving.

(31) Rocker or "cradle"-type dumping cars should be equipped with an efficient positive locking device.

(32) Brakemen should be prohibited from riding on cars of the "rocker" or cradle type.

(33) In handling railroad cars, brakemen should

- (a) Use a suitable brake stick.
- (b) Wear a safety hat.
- (c) Use a railroad-type pinch bar for shifting cars.
- (d) Wear snug-fitting clothing.
- (e) Be prohibited from riding on the front foot board of a light locomotive. Employees should ride on the trailing footboard or in the cab of the locomotive.

(34) A switchman should

- (a) Be required to ride the front end of all trains that are being pushed.
- (b) Get off a moving locomotive from the side, well in the clear of the footboard.
- (c) Not stand on or between the rails when mounting a moving locomotive.
- (d) Not be permitted to ride between slag pots or between slag pot and locomotive.

(35) Before spotting a slag pot for filling, it should be inspected carefully to insure that no water is in the bottom of the pot.

(36) Pots and ladles should not be filled so full as to cause spillage.

(37) Before dumping slag in a new place, the motorman should investigate to insure that no one will be endangered by the hot slag.

(38) Trucks should be maintained in good condition and should not be driven if unsafe.

(39) Trucks used for hauling rock or overburden should be equipped with overhead protection for the cab and driver.

(40) Only authorized persons should be permitted to drive trucks.

(41) A truck driver should not remain in the cab of the truck while it is being loaded with a power shovel if the dipper is swinging over the cab.

(42) Truck drivers should acquire the habit of checking the brakes by trying them, just as each start is made.

(43) Truck drivers should not exceed local speed limit and should drive slower if unsafe road conditions require it.

(44) Trucks should be driven under control at all times. Driving a truck with the gears out of mesh (coasting) should be prohibited.

(45) Before ascending or descending a steep grade, a gear should be selected that will insure safe driving and make changing gears unnecessary while going up or down.

(46) Before leaving a truck on a grade, the driver should head or back it into a bank and set the brakes.

(47) No smoking or open lights should be permitted during refueling operations.

(48) No repair work of any nature should be permitted on dump trucks when truck box is in dump position, unless box has been properly blocked.

18. Underground Haulage

(1) Haulage roads should be kept free of spillage and debris.

(2) Rails should be heavy enough to carry safely the heaviest rolling stock and should be firmly attached to ties of adequate size and spacing.

(3) On all haulage roads, rail joints should be connected with plates or welded, and rails should be well-supported by ties.

(4) The track should be well-aligned and free from high or low joints, broken rails, defective switches, defective frogs, and improperly aligned frogs.

(5) Roadbed should be kept well-drained and surfaced.

(6) Where practicable, there should be a continuous clearance on one side of at least 30 inches from the nearest obstruction to the farthest projection of moving equipment.

(7) Safety stations (shelter holes) should be provided on all haulage-ways where clearance is not provided. Employees should be prohibited from attempting to pass along the side or between the cars of a moving train.

(8) Timber or other material should be piled so as to leave ample room for clearance between the piles and the train.

(9) Frogs, guard rails, and lead rails should be blocked if there is danger of persons catching their feet in them.

(10) Track switches should be provided, complete with parallel throws and bridle bars.

(11) The rod extending from the bridle bar to the throw should be covered, or the stumbling hazard should otherwise be minimized.

(12) Track and ditch cleaning in main haulage drifts should not be done while locomotives are in operation.

(13) Where two or more locomotives or other self-propelled track-mounted equipment are operated independently on the same track, a block or telephone signal system should be used to control their movement.

(14) Locomotives should be provided with efficient headlights and warning devices.

(15) Car rerailers, jacks, and other necessary tools for rerailing cars and locomotives should be on the locomotive at all times.

(16) Riding on locomotives should be prohibited except to those operating the trip and persons authorized by management.

(17) An official or other authorized person should be in charge of and accompany each man-trip.

(18) Man-trips should be operated at a safe speed.

(19) Enough cars should be provided on man-trips to permit all men to ride inside the cars and prevent crowding.

(20) Men on man-trips should not ride in the car next to a trolley locomotive unless such car is specially designed to afford front-end and overhead protection.

(21) When riding in a car on a trolley haulage road, men should ride on the side of the car opposite the trolley wire, unless suitably covered man-cars are used.

(22) The oncoming train crew should inspect locomotives and cars to see that all the equipment is in working order.

(23) The motorman should keep the train under such control that it can be stopped within a distance that can be seen ahead, or within the distance to the next crossing or turnout.

(24) Locomotives should be slowed down when

- (a) Men are alongside the track.
- (b) Train is passing chutes or rounding curves.
- (c) Passing places where men are known to be working.
- (d) Passing switches.
- (e) Passing through ventilating or other doors.

(25) Movement of trains through shaft stations should be prohibited while men are entering or leaving the cage.

(26) Trains should be pulled rather than pushed when at all possible.

(27) The locomotive should not attempt to pull a train over a track covered with rocks, timber, or trash.

(28) Back-poling should be allowed only at places where the trolley pole cannot be reversed and at very slow speed of the locomotive.

(29) Coasting with the trolley held down should not be permitted.

(30) "Flying switches" should be forbidden.

(31) Cars should be securely blocked before leaving them on a grade.

(32) Crossovers should be inspected before moving a car across them.

(33) One or more empty cars should be placed between locomotive and a car hauling rails, pipe, or similar material.

(34) When the motorman leaves a locomotive, even temporarily, the controller should be set at neutral, the brake set tightly, and the trolley connection removed from the wire.

(35) The motorman should be made responsible for the safety of the train crew.

(36) Motormen and brakemen should be required to wear snug-fitting clothing.

(37) No one should be permitted to ride between cars or on top of loaded cars.

(38) Getting on or off moving cars or locomotives should be prohibited.

(39) Brakemen should never attempt to throw a switch while riding on a moving train.

(40) Cars should not be coupled or uncoupled while they are in motion.

(41) Short pieces of rail, ties, or boards should not be used to raise or slue derailed cars and locomotives.

(42) Train crews should not attempt to make electrical repairs to the locomotives. The need for repairs should be reported to the foreman or the electrician.

(43) No chute should be pulled in a stope until the men in the stope have been notified.

(44) Chutes should not be drawn entirely empty; a little material should be left in the bottom to prevent rock from flying when more broken material is dumped into the chute.

(45) Men should never climb into a chute that is "hung up".

(46) Standing on top of a car while loading it from a chute should be prohibited.

(47) When loading a car from a chute, care should be taken that rocks do not roll over the sides.

(48) The chute should be properly blocked and the lip of the chute should be cleaned before moving the car away from the chute.

(49) The car should be properly trimmed, to prevent rocks sliding or rolling against the hands, before starting to push the car.

(50) When pushing or dumping a car, care should be taken that the hands are in a safe position.

(51) When cars are moved by hand, they should be pushed, not pulled.

(52) Gasoline engines should not be used underground.

(53) Diesel locomotives or trucks may be used under the following conditions:

- (a) The fuel-injection system should be locked to prevent unauthorized changing of air-fuel ratio.
- (b) The fuel should have a flash point of 150° F. or higher and contain less than 0.2 percent sulfur by weight.
- (c) A cooling system should be provided for the exhaust gas of the engine.
- (d) Under normal operating conditions, the undiluted exhaust gas of the engine should not contain more than 0.10 percent by volume of carbon monoxide.

- (e) Provision should be made to dilute the exhaust gas with air to not more than 100 part per million by volume of carbon monoxide before it is discharged into the surrounding atmosphere.
- (f) The percentage of carbon monoxide in the general mine air because of the exhaust gas of the engine should not exceed 0.002 percent (20 p.p.m.). Experience has demonstrated that acceptable atmospheric conditions are attainable when this percentage of carbon monoxide is not exceeded.
- (g) The use of Diesel equipment should be restricted to places where positive ventilation is maintained by mechanical ventilation.
- (h) The quantity of air supplied should be adequate to dilute all toxic constituents of the exhaust (75 cu. ft. per min. per rated horsepower at maximum speed and load has been used as a safe minimum in some tunnel work in normal air).
- (i) The air in which Diesel engines are used should be sampled and analysed at intervals to determine that other noxious gases, such as oxides of nitrogen, carbon dioxide, aldehydes, and sulfur dioxide are within acceptable limits.

19. Electricity

- (1) All electric wiring should conform to the National Electrical Code, and all line work should conform to the rules recommended by the National Electric Light Association.
- (2) Overhead high-potential power lines should be placed at least 15 feet above the ground, 20 feet above driveways, and supported and guarded adequately to prevent contact with other circuits.
- (3) Guy wires from poles supporting high-potential transmission lines should be grounded unless equipped with insulators. If insulators are used, they should be installed near the poles.
- (4) The surface electrical equipment and overhead power circuits should be adequately protected against lightning or voltage surges.
- (5) High-potential power lines should be protected adequately by circuit breakers.
- (6) Combustible material should not be stored or allowed to accumulate under power lines. If this is not feasible, the overhead power lines should be taut, properly supported, and long spans should be shortened, if possible.
- (7) The electric circuits should be of ample capacity for the current carried.

(8) A surface transformer, within 8 feet of the ground, should be enclosed in a transformer house or by a substantial fence suitably located and at least 6 feet high.

(9) The gate or door to the transformer enclosure should be kept locked at all times, unless authorized persons are present.

(10) DANGER-HIGH VOLTAGE signs should be placed on all transformer enclosures, high-potential switchboards, and other high-potential installations.

(11) Casings of all transformers should be grounded unless isolated (free from contact hazard by position).

(12) Switchboards should

- (a) Have ample working space around and back of them, free of rubbish and stored material.
- (b) Have entrance at each end to permit authorized persons to inspect, adjust, or repair apparatus back of switchboard.
- (c) Be adequately lighted.
- (d) Have control readily accessible for emergency shutdown.
- (e) Have disconnecting switch on incoming circuit at or near entrance to rear.
- (f) Have entrance to rear guarded against unauthorized entrance.

(13) All metallic frames, casings, and coverings of motors, generators, switchboards, and other electrical equipment that can become "alive" through failure of insulation or by contact with energized parts should be grounded.

(14) Dry wooden platforms, rubber mats, or other electrically nonconducting material should be kept in place at all switchboards and machinery where shock hazards exist.

(15) Electric wiring in all surface buildings should be so installed as to present minimum fire and contact hazards.

(16) All principal switches should be marked so that they may be found readily in case of emergency.

(17) Officials, haulage crews, electricians, and persons connected with electrical maintenance should be familiar with the location of cut-out switches.

(18) Circuit breakers should be provided to protect all power circuits; if they are automatic, they should be set so that the circuits cannot be overloaded.

(19) Switches and circuit breakers should be so installed that they are readily accessible and can be operated without danger of contact with moving or live parts.

(20) Switches and starting boxes used to control electric circuits should be of a safe design.

(21) All electric appliances, machines, and conductors should be large enough for the work required of them.

(22) All metallic coverings and armor of cables and of conduit should be grounded and electrically continuous, so as to afford a conductor path for the ground circuit.

(23) Power conductors in shafts or boreholes should be fastened securely in such a way as to prevent undue strains in the sheath, insulation, or conductors.

(24) Power wires should be supported on or by well-designed and installed insulators.

(25) Power should be cut off from idle sections of a mine and from the entire mine on nonworkdays. This statement, however, is not intended to bar the use of lines properly protected by fuses for the operation of units such as pumps.

(26) Trolley wires should be:

- (a) Securely supported on insulated hangers not more than 30 feet apart.
- (b) Properly aligned and placed at least 6 inches outside the rail.
- (c) Installed on the opposite side from the clearance side and shelter holes.
- (d) Sectionalized by proper switches at intervals not to exceed 1,500 feet; switches should also be installed in all branch lines near their beginning.
- (e) Placed as high as practicable to reduce the hazard of employees coming in contact with the wire. Trolley wires less than 6½ feet from the rail should be guarded.
- (f) Properly guarded at both sides of doors and at all chute mouths.

(27) The voltage of trolley circuits should not exceed 275.

(28) Where a grounded return system is used, all underground metallic pipe lines that are 1,000 feet or more in length, and all metallic pipe lines leading outside the mine, should be bonded to the return at the ends and at intervals not exceeding 500 feet.

(29) If the track is used for the return circuit, both rails should be well-bonded at every joint and cross-bonded at least every 200 feet.

(30) Ground connections should be tested frequently to determine their continuity and occasionally to determine their resistance.

(31) Cables for portable or semiportable underground electric equipment should be provided with suitable taps equipped with fuses, unless properly connected to junction or distribution boxes.

(32) Underground electric stations for installations of pumps, compressors, motor-generator and other conversion equipment, storage battery-charging stations, and transformers should be located in well-ventilated, fireproof rooms.

(33) Portable pumps and other portable electric equipment should be installed so as to constitute the minimum possible fire or contact hazard. They should be used only in well-ventilated places.

(34) Wiring in underground structures should be insulated and installed properly.

(35) Electric equipment should be protected against excessive overload by fuses or equivalent protective devices of the correct type and capacity.

(36) Wires or other conducting materials should not be used as a substitute for properly designed fuses.

(37) Rheostats and electric heaters should be so installed as to prevent electric shock, burns, or fires.

(38) Electric motors, switches, and controls, exposed to dust or water in crushing plants and mills should be of dust-tight or water-tight construction.

(39) Drills and other electric tools intended to be held in the hands should not be operated at a potential higher than 250 volts; the metal frames of such equipment should be effectively grounded.

(40) Electric drills or other electric rotating tools intended to be held in the hands and, where feasible, post drills should have the electric switch so constructed as to break the circuit when the hands release the switch. In addition, it is desirable that drills be equipped with friction or safety clutch.

(41) Lighting circuits should be provided with adequate fuses.

(42) Lighting wires should be supported by suitable insulators: if connected to the trolley or power line, suitable clamps should be used.

(43) The ground connection for lighting wires taken off the trolley circuit should be made to the track circuit.

(44) Lamp sockets with exposed metal parts should not be used underground.

(45) Electric lights should be so placed that they cannot come in contact with combustible material.

(46) Portable extension lights should be equipped with lamp guards at all times.

(47) Telephone circuits on the surface should be protected by lightning arresters (protector blocks).

(48) Telephone wires underground should be installed on the opposite side from power or trolley wires if practicable.

(49) Telephone wires crossing power or trolley wires should be adequately insulated.

(50) Telephones should be grounded or protected by insulating transformers (repeating coils).

(51) Signal wires should be supported on insulators and should be guarded where they cross other power circuits.

(52) Bare signal wires should not carry more than 30 volts. (This does not apply to block-signal systems.)

(53) At each mine where electricity is used underground, all wiring and equipment should be inspected systematically at regular intervals (at least once a month). A written or oral report of each inspection should be made to the mine foreman by the mine electrician or inspector. Equipment and circuits found to be defective should be removed immediately from service until repaired.

(54) The mine electrician should have charge of the electrical apparatus and its installation, maintenance, and repair.

(55) Electrical equipment should be repaired only by a competent electrician.

(56) Employees should not depend entirely on the insulation of electric wires as a protection against shock.

(57) No work should be done on electrical circuits and apparatus when the current is on, unless conditions make it absolutely necessary, in which case adequate precautions should be taken.

(58) Precautions for working on live circuits should include insulated foot supports, such as rubber boots, dry ladders, or insulated platforms, and approved rubber gloves, approved shields, and blankets for covering live parts and grounds.

(59) Lines or circuits should be disconnected by the electrician in charge or by the authorized switchboard or substation attendant. They should be closed only by the electrician who disconnects them or, at his direction, by the switchboard or substation attendant.

(60) Switches on the line or circuits that have been disconnected to make repairs or adjustments should be locked or tied out and placarded "DANGER - MEN WORKING ON THIS CIRCUIT - DO NOT CLOSE."

(61) No person other than the man opening or ordering the circuit opened should close it.

(62) A circuit switch should not be closed unless it is positively known that no one is working on the circuit.

(63) Disconnecting switches should not be thrown until after the load has been taken off.

(64) Fuses should not be inserted in a circuit until after the switch has been opened. Insulated hooks should be used to open high-voltage switches.

(65) Fallen high-tension wires should not be left unguarded unless it is necessary and safe to do so.

(66) Insulated cable tongs or insulated cable hooks should be used in handling high-tension power cables. The cables should never be handled with bare hands. Rubber gloves may be used if the gloves are in a safe condition.

(67) Trailing power cables should be fastened firmly to the shovel before moving the shovel. The cables should never be pulled by their terminal connections.

(68) Power cables should be connected to the transmission line at the nearest outlet to avoid trailing long lengths of cable.

(69) Low poles or wooden horses to support power cables in open pit are recommended.

(70) Electric cables should not lie in water, but should be supported on benches when necessary.

(71) Splicing of power cables while the power is on should be prohibited.

(72) Temporary cable splices should be made in a workmanlike manner, mechanically strong, and well-insulated. Preferably, when a cable is defective, a stand-by cable should be used, and the defective cable should be sent to the shop for permanent splicing and, if practicable, vulcanizing.

(73) Safety goggles and masks should be worn when working with a soldering pot and ladle.

(74) Linemen should wear safety belts fastened around the pole and not on arms or braces.

(75) Instructions for the resuscitation of persons suffering from electrical shock should be placed and maintained in surface and underground electrical stations.

(76) Employees working in or around electrical equipment should be trained in the resuscitation of persons suffering from electrical shock and in general first aid procedures.

20. Machinery and Safety Appliances in Connection Therewith
(Surface and Underground)

(1) Machines and apparatus should not be operated without authorization from the foreman.

(2) No person should use equipment with which he is unfamiliar or uninstructed.

(3) Machinery and belting exposed to possible personal contact should be guarded adequately, as indicated below:

- (a) Gears, sprockets, friction devices, and couplings with protruding bolts or nuts should be completely guarded.
- (b) Shafting and projecting shaft ends within 6 feet of floor or platform level should be completely guarded.
- (c) Vertical or inclined belt, chain, or rope drives should be suitably guarded to a height of at least 7 feet from the floor.
- (d) Horizontal belt, chain, or rope drives within 7 feet of floor or platform should be guarded.
- (e) Fly wheels should be guarded; where they extend more than 6 feet above the floor, they should be guarded to a height of at least 6 feet.
- (f) Circular and band saws and planers should be kept adequately guarded.
- (g) Locomotive pits should be well guarded, and the guard should be kept in place when the pit is not in use.
- (h) When guards are removed for oiling or repairs or for other purpose they should be replaced before the machine is put in operation.
- (i) Projecting set screws should be prohibited; split collars with countersunk set screws are recommended.

(4) Adequate clearance should be provided at machine installations, and passageways should be kept free of stumbling hazards.

(5) Surface machines should be adequately illuminated.

(6) Steps, handrails, grab irons, and floors should be kept free from grease, wire, and debris.

(7) Mechanically operated grinding wheels should be equipped with

(a) Safety washers.

(b) Substantial retaining hoods, the throat openings of which do not expose more than a 90° segment of any wheel and preferably not more than a 60° segment.

(c) A dust-collecting system to remove liberated dust or a permissible respirator should be worn by the operator.

(d) A suitable eye shield or goggles should be worn by the operator.

(8) Materials being drilled with a power drill should be securely fastened so as not to require holding the materials with the hands.

(9) Riding on conveyors and bucket elevators should be prohibited.

(10) Repairs or adjustments should not be made on any machinery until the power has been cut off and the machinery blocked securely against all motion.

(11) Line shafting should never be oiled while shafting is in motion.

(12) Belts should be shifted only with a belt stick or other mechanical device.

(13) Belt dressing should not be put on conveyors in motion.

(14) Oilers and persons working around machinery with moving parts should be required to wear tight-fitting clothes.

Hand Tools

(15) Tools with mushroomed heads, hammers with loose handles, files without handles, and wrenches with sprung jaws should not be used.

(16) Wrenches of proper size should be used for each job; improvised extension of wrench handles for greater leverage should be prohibited.

(17) Men holding chisel bars or steel should stand on the opposite side from the sledge man when there is room to do so.

(18) Tools with sharp edges or points, such as rakes, shovels, coke forks, etc., should be piled with sharp points or edges down.

(19) Heavy bars should be laid flat, not left standing on end.

Welding and Cutting.

(20) Stationary welding locations should be well-ventilated.

(21) Electric welding should be shielded to prevent the electric arc from being seen by other employees; otherwise serious eye burns may result.

(22) Welders goggles should be worn while using gas welding or electric welding equipment; otherwise serious eye burns may result.

(23) Gas welding equipment should be used in conformity with the manufacturers' safety rules furnished with such equipment.

(24) Gas and acetylene tanks should not be dropped, bumped, or otherwise roughly handled. Precautions should be taken to prevent gas cylinders from falling over when standing on end.

(25) The hose of gas welding apparatus should be kept in good condition at all times.

(26) The pressure-reduction valves on gas welding equipment should be tested frequently.

Compressed Air Drills

(27) "Horse-play" with compressed air should not be allowed.

(28) Operating an air drill without water (dry drilling) should be forbidden; dry drilling is prohibited by law in many States.

(29) A drill wrench should be used to remove a drill steel.

(30) Care should be taken that the wrench does not slip when pulling on it to remove a drill steel.

(31) The back should be examined for loose rock when drilling is in progress and before taking down the drill column.

(32) Soft hammers should be used in taking detachable bits off rods.

Shovel Loaders

(33) No person should be permitted to operate a power shovel while standing on the ground.

(34) When moving a power shovel into and out of a working place, the bucket should be securely blocked in the "up" position.

Scrapers

(35) The scraper hoist should be lined properly and spragged securely before starting scraping operations.

(36) Sheaves for head and snatch blocks should be examined daily to be sure that they are maintained in good condition.

(37) Provisions should be made to give signals promptly to the scraper-hoist operator when making a long pull or scraping around corners.

(38) The scraper operator should not move the scraper at any time until he knows that other men are in a safe place.

(39) No one should be allowed to stand or walk in front of any scraper blocks or along the line of the scraper rope when the scraper is in motion.

(40) Employees should be prohibited from holding on to the scraper rope when climbing into a stope.

(41) The scraper crew should clean the track around the chute or slide before moving to another place.

(42) The scraper or drag operator should be protected from the danger of rope failure by a guard mounted over the segment of the drum near the operator, which should not obscure the rope windings and the sheaves and their support.

Smelter Cranes

(43) Cranes should be equipped with audible signal devices to warn of danger.

(44) Craneman should be permitted to move the crane only on signal of the swamper or foreman.

(45) When the crane is in motion, the hooks or load should clear the floor by at least 7 feet.

(46) A swamper should always walk ahead of loads being carried in slings or tongs.

(47) Hoisting should be done only when the trolley is directly over the load.

(48) Trolley should be in center of bridge when running light.

Stiffleg Derricks in Deep Pits

(49) Ropes, slings, chains, cables, sheaves, gears, and other parts of derricks and hoisting apparatus should be examined daily by competent persons.

(50) Wire-rope slings, grab hooks, or chains should be used to attach the blocks of stone to the hoisting apparatus.

(51) Hand-operated derricks should be equipped with brakes, which can be operated from either side of the drum.

(52) The wire rope guys supporting the masts of a derrick and their wire fastenings should be inspected at least semimonthly.

21. Fire Protection Underground

(1) Water for fire protection should be available throughout the mine.

(2) Water lines underground should be provided with outlet connections near combustible material.

(3) Connections should be provided for turning water into the air line in the event of fire.

(4) A timbered entrance less than 45° from the horizontal should be fireproofed at least 200 feet from the portal.

(5) Wood-lined shafts should be fireproofed; if it is not practicable to fireproof them, adequate protection against fire should be provided.

(6) Shaft stations should be adequately protected from fire hazards; some mines have a firehose connection from the pump column that can be used in case of fire.

(7) If transformers containing flammable oil are installed underground, means should be provided to drain or confine the oil in event of rupture of the transformer casing.

(8) Sand or rock dust should be available at electrical installations; in well-ventilated sections, carbon tetrachloride or carbon dioxide fire extinguishers should be provided.

(9) A stench method of fire warning should be provided where compressed air is used.

(10) A well-planned procedure should be adopted to be followed by underground employees when the stench warning is given.

(11) Practice fire drills should be given once or twice a year and should include a requirement that all underground employees meet at designated places.

(12) The stench used as a warning agent should be blown out of the working places as quickly as possible after each practice use.

(13) Fires for heating should not be permitted underground. Open-flame torches, lighted acetylene lamp, and candles should not be left unattended.

(14) Before using oxyacetylene equipment, all adjacent dry timber should be thoroughly wet down.

(15) If oxyacetylene cutting or welding equipment has been used on any work in the shaft or immediately above it, all adjacent timber should be inspected thoroughly for fire.

(16) All timbered shaft stations on levels where oxyacetylene cutting or welding has been done during the shift should be inspected for fire at the close of the shift, and a record of the inspection should be kept.

(17) Flammable material should not be allowed to accumulate at or near underground stations.

(18) Oils, greases, and other flammable liquids should not be stored at a shaft station.

(19) Lubricating oil and grease for use in working places should be in portable, closed, metal containers.

(20) Hay, straw, or flammable feed material taken underground should be in compressed bales, or covered by tarpaulin, or in a container, or in a closed car. It should be delivered promptly to the underground stable and stored in a locked fireproof compartment. The amount of hay stored underground at any time should not exceed the amount normally consumed in 48 hours, unless this amount is less than 1 bale.

(21) Spontaneous ignitions of waste material in mines having sulfide ores, carbonaceous shales or similar strata, or high rock temperatures should be prevented or controlled by sealing, proper mining method, ventilation, or removing the offending material.

22. Miscellaneous Hazards

(1) An accurate map of the mine, brought up to date at least every 6 months, should be posted in a convenient place accessible to employees.

(2) The map posted at the mine should show, in addition to the mine workings

(a) Direction of air currents passing through main shafts, drifts, crosscuts, and working places, by arrows in colors.

(b) Location of doors, overcasts, and regulators.

(c) Location of telephones, power and trolley lines, and permanent electric equipment.

(3) When advancing a face in an area where water may be encountered, a drill hole should be kept at least 20 feet ahead of the face; if necessary, holes should be drilled radially from the walls of the drift. Water doors should be provided, if other workings in the mine may be flooded by an inrush of water at the advancing face.

(4) Oil and gas wells penetrating strata below beds being mined should be protected by a pillar extending at least 50 feet from the well in every direction.

(5) In regard to mine openings:

(a) Every underground mine should have at least two separate outlets to the surface.

(b) It is not necessary that the two main outlets belong to the same mine if persons can travel safely to and out of either outlet from another mine.

(c) When a new mine is being opened, or when a new drift or level is being worked for the purpose of making a connection between the two main outlets, not more than 20 persons should be allowed at any one time in such mines, drift, or level.

(6) Main manways should be readily accessible from every section of the mine and should be kept in safe condition, reasonably free from steam, dangerous gases, standing water, ice, falls, broken timbers, and other obstructions.

(7) Designated manways should be large enough to allow men to travel safely.

(8) Direction signs should be posted conspicuously to indicate designated manways; they should be kept in legible conditions, and means should be taken to inform employees about them.

(9) The manway compartment of a shaft should not be so crowded with water and air lines as to prevent the safe, free passage of men; it should be separated from other compartments by partitions made of boards or heavy wire screen.

(10) Ladders should be provided in all shafts and raises traveled by men if such shafts or raises are steeper than 30° from the horizontal.

(11) The ladderway should be maintained from the lowest workings in the mine to the surface.

(12) Vertical or steeply inclined shafts should have sollars in all ladderways, as required by state law, but not farther than 30 feet apart.

(13) Toeboards should be placed around the ladder passageways.

(14) All underground ladders should be of substantial construction and maintained in good condition. Care should be taken to keep the ladderways, including sollars, free from loose rocks.

(15) The distance between the center of the rungs should be 12 inches, and the ladder rung should be at least 3 inches from the wall or other obstructions behind them.

(16) Ladders should not incline backwards from a vertical position.

(17) Ladders should extend a safe distance above the sollar floor; a distance of at least 3 feet is recommended.

(18) Men should always face the ladder and use both hands, whether climbing up or down.

(19) Before starting up a raise in which men are working, warning should be given so that they may know someone is ascending.

(20) A check-in-and-out system should be adopted that will provide positive identification of every individual underground.

(21) Individual lamps, preferably permissible portable electric cap lamps, should be carried for illumination by all persons in a mine.

(22) Each workman underground should wear a hard hat, hard-toed shoes, or hard-toed rubbers, and should be supplied with a pair of goggles.

(23) Goggles should be used to prevent injury to the eyes when starting holes, picking solid bottom, picking large rock, standing near anyone who is breaking rock, blowing out holes with compressed air, or any other procedure in which flying particles maybe produced.

(24) Employees handling wire rope should be required to wear heavy leather gloves or mitts.

(25) The carrying of drill steel, pipe, mine rails, or other metallic material on the shoulder under a trolley wire should be prohibited.

(26) Dusty chutes and transfer raises should be equipped with sprays, and the sprays should be used whenever trains are being loaded or whenever waste or ore is being passed through raises.

(27) Potable drinking water should be supplied in places accessible to employees.

(28) Dry closets, water closets, or closet cars should be provided in main working levels for the use of the men employed in the mine and should be maintained in a sanitary condition.

(29) All refuse and waste from stables should be removed from the mine promptly and not allowed to accumulate.

GENERAL SAFETY CONDITIONS

23. Supervision

(1) The foreman or other person in charge of underground operations and all assistant foremen should have a certificate of competency from the State, if the State issues such certificates. A record of foremen's certificates should be kept at the mine.

(2) Second exits and other portions of the mine not regularly visited should be inspected at least once a month for fire hazards and deterioration of ladders or other appliances necessary to maintain an adequate escapeway.

(3) All entrances to dangerous places should be sealed or fenced off and suitable danger signs should be provided at safe distances from the hazard.

(4) A statement of all dangerous conditions observed should be recorded in ink daily in a book, signed and dated by the mine foreman, and countersigned by the superintendent.

(5) Each working place should be inspected for safety by an official at least once each working shift, and at such more frequent periods as may be necessary and practicable.

(6) No man should be employed at a working place at such a distance from some other employee that his cries, in case of need, cannot be heard, unless he is in communication with another employee at least once every 2 hours.

(7) Experienced men should work with new men whenever possible.

24. Safety Organization

(1) A safety engineer or director should be employed for mines employing 100 or more persons.

(2) A safety organization of officials and employees should be established if practicable.

(3) Joint safety meetings of men and officials should be held at least monthly.

(4) A bulletin board should be provided and posted with suitable bulletins, which should be replaced by new material from time to time.

(5) Accidents involving injury to persons and other serious accidents should be investigated and a record kept of such investigations.

(6) Responsibility for accidents should be placed, if it is feasible to ascertain such responsibility.

(7) A safety committee, including workmen and officials, should inspect the mine periodically and submit recommendations for correcting hazards observed.

(8) A record should be kept of all lost-time accidents; these should be summarized monthly, as well as annually, and studied with a view to correcting bad practices.

25. Safety Rules and Standards

(1) Special company rules regarding mine safety should be adopted and published; they should be approved by the State agency that governs mining, where such approval can be obtained.

(2) New employees should be fully instructed regarding the company safety rules and the particular hazards incident to their work; this applies to both experienced and inexperienced personnel.

(3) Where practicable, new employees should be furnished with a copy of the safety rules of the mine.

(4) Employees should become conversant with the State mining law; this should be done by instruction and assistance, as may be obtained, from the company or available educational agency. Compliance with the mining law should be required of all employees.

26. First Aid and Mine Rescue

(1) All employees (underground and surface) should be given first-aid training as soon as possible after being employed.

(2) If feasible, additional first-aid training should be given to all employees annually or at some other stated period.

(3) Adequate first-aid material should be provided on the surface and underground and should be kept in clean, usable condition.

(4) A stretcher, a woolen blanket, and a waterproof blanket should be maintained in good condition in a place convenient and accessible to employees.

(5) At least 10 sets of oxygen breathing apparatus and at least 6 gas masks and necessary accessories should be available in each mining region for use in event of mine fire or explosion or other occurrence in which dangerous atmospheric conditions may be encountered. This equipment should be available at centrally located rescue stations owned by the State or by operators in the district or by individual companies. This equipment should be readily available in good condition at all times.

(6) When training facilities are available, at least 12 men should be trained in mine rescue work at mines having more than 100 employees; mines having 100 employees or fewer should have a proportionately smaller number trained, but in no case should the number be less than 6.

(7) Additional mine rescue training should be given monthly if training facilities are available.

(8) Mine officials should take an advanced mine rescue course when such course is available.

TN 295

U5

1946

LIBRARY OF CONGRESS



0 002 951 315 6